The Pennsylvania Canal:Delaware Division
~~(Plumstead Township)~~ Point Pleasant vic.
Bucks County
Pennsylvania

HAER No. PA-103

HAER
PA,
9-POPLE.V,
1-

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
MIDATLANTIC REGION, NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HAER
PA,
9-PO PLE,
1-

HISTORIC AMERICAN ENGINEERING RECORD

DELAWARE DIVISION OF THE PENNSYLVANIA CANAL

HAER NO. PA-103

Location: 700 foot northwest-southeast linear segment of the canal between locks 14 (upstream) and 13. Lock 13 is c. 300 feet east of the Mountainside Inn (a historic landmark) across Pennsylvania Highway 32. Property is in Plumstead Township, Bucks County, Pennsylvania, immediately south of the village of Point Pleasant.

UTM: 18.490460.447420
QUAD: Lumberville, New Jersey-Pennsylvania

Date of Construction: 1827-1832

Present Owner: Commonwealth of Pennsylvania

Present Use: No commercial use; currently maintained as a historic landmark by Pennsylvania Department of Environmental Resources

Significance: The Delaware Canal was the last surviving towpath canal in the United States, its function terminating in 1931. It was one of the principal routes for commercial transportation in the eastern United States during America's industrial expansion in the late nineteenth century. The building and long-term maintenance of the canal was largely the result of the efforts of Josiah White, one of the nation's leading entrepreneurs, to efficiently transport anthracite coal and other key raw materials to processing and distribution centers in the mid-Atlantic region.

Project Information: Documentation was initiated in December 1982, following the terms of a Memorandum of Agreement between the contracting agency, the Neshaminy Water Resources Authority, and the regulatory agencies, the U.S. Army Corps of Engineers (Philadelphia District), the Pennsylvania State Historic Preservation Officer, and the Advisory Council on Historic Preservation. Gilbert/Commonwealth undertook the canal study as part of a comprehensive cultural resources investigation of the Point Pleasant property. Property plans included construction of a pumping station with an intake structure that crossed the canal to the Delaware River. The canal investigation are associated with this impacted canal segment.

Dr. Joseph Schuldenrein and Ms. Beverly Bastian
Senior Cultural Resource Managers
Gilbert/Commonwealth Inc.
Jackson, Michigan 49201

DOCUMENTATION OF SITE CONSTRUCTION

The Delaware Division of the Pennsylvania Canal parallels the Delaware River along the west side for a distance of 60 miles, from Easton to Bristol (Sheire 1976: item 8, p. 2). In the Point Pleasant-Lower Black's Eddy area the canal was excavated into the T-0 or floodplain surface, which grades upward at a 7.5 percent incline from the water level to the Delaware Valley side slopes. This is the only extensive alluvial landform in the study area. The valley slopes begin immediately to the west of the canal and are composed largely of mixed till, slump materials including argillite and sandstone derived from the scarp, and colluvium. From the canal east, the terrace is built of naturally stratified floodplain gravels (at the base), sands, silts and clays capped by interdigitated wetland silts and clays and heavy, highly organic canal dredgings. Cultural materials are dispersed throughout the canal fills; they are mostly of the historic period. Flanking the canal to the southeast are remnants of a significant prehistoric site, the Mercer Mound, which contains stratified Late Woodland and probable Late Archaic/Transitional components. The mound lies to the south of the wetlands area, where most of the canal fills were dumped and it remains largely intact below disturbed deposits of later historic age. The canal and wetlands deposits preclude agricultural use of the eastern tract, while the western portion is too clay-rich and rocky to have supported sustained crop growth. Effectively, archeological deposits pre-dating 1832, the year of canal completion, are geologically sealed and in probable primary context.

Figure 1 illustrates a representative cross-section of the canal. This particular section was examined because it highlights the natural stratification of deposits from the valley slopes to the west that contrast with the constructed towpath flanking the canal to the east. Central to the interpretation of this portion of the canal is the prediction made by planner Josiah White during construction that the Point Pleasant division was neither exposed to great damage nor would it require much repair (Yoder 1972:110). This relatively trouble-free section is first, a product, of an inland location removed from the ravages of flooding and, second, a result of the clay-content of the substrate which forms an impermeable barrier to drainage. Water was therefore retained over the long-term and protracted siltation only enhanced this trend. While flooding periodically damaged major stretches of the Pennsylvania Canal, notably in 1841, 1845, 1862, 1869, 1885, 1902, 1936 and 1955, reference to specific canal destruction in the project vicinity is limited to the flood of 1885 where waters "...carried away the aqueduct at Lumberville and washed out the Culvert at Kenderdine's Mill (Cuttalossa Creek)" (Yoder 1972:125). Since minimal structural modifications were made along the stretch between locks 13 and 14, it is not surprising that the stratigraphy recorded is relatively simple and devoid of complex layering. From what can be inferred, canal maintenance essentially involved periodic dredging and silt removals which would leave neither complex records of sedimentation nor remnants of intricate canal walls and retaining structures.

Figure 1 shows the disposition of primary depositional units in the representative cross-section. Table 1 describes the sedimentology and stratigraphic properties of these deposits. It is noted that for purposes of gross site stratigraphy all canal units belong to stratum 6 of the master project stratigraphy. Sub-units are designated alphabetically by upper case letters. The sub-units are generally tabulated in order of increasing age down the column, with "A" representing the fill used to build-up the towpath and "G" consisting of the Pleistocene-aged clay-till into which the canal was initially excavated. The profile itself cuts through the canal floor, which generally ranges from 4 to 5 feet (1.2 to 1.5 m) below the elevations of the flanking site surface.

The stratigraphy and sedimentology show that the most significant event in the history of the canal between locks 13 and 14 was the lining of the canal with impermeable clays (stratum F) following initial excavation into Pleistocene clay-till. There is little historic information regarding the actual installation of the clay-lining, but the similarity in composition and consistence between the till and lining clays, as well as the analogous morphologies and sizes of the boulders in each matrix, strongly suggests that the primary source of the lining was the till. Contrasting colors between the sediments is probably a function of both compaction of the lining clays during construction and waterlogging once the canal became functional. It is also highly possible that Delaware floodplain clays were mixed in with the lining to further reduce permeability. Subsequent siltation also enhanced this trend. Most of the major modifications to the canal banks, and presumably those involving the maintenance of the canal bottoms, occurred between 1832 and 1878 (Yoder 1972:120).

While canal construction and maintenance largely account for the homogeneous appearance of the lining, it must be noted that periodic dredgings have altered the composition of the upper levels of the deposit. In this connection, a relatively recent (c. 1950s) soda pop can and several rubber tire fragments found towards the top of the stratum are significant insofar as they document minimal deposition along the canal bottoms locally for an approximate 70-year interval (c. 1880-1950). Significant erosion did take place, especially during the Depression years (1931-1940) when normal maintenance of the canal was practically non-existent. Most of the lining caps were eroded away by floods, beginning with the inundation of 1885 and continuing to 1955.

Historic artifacts and sedimentology provide firm indications that the 50-100 cm of deposit currently flooring the canal are products of the past 30 years. Stratum E is a humified leaf mat whose origins and depositional history are difficult to ascertain. The mat underlies both the laterally extensive canal fill 1 (stratum B) as well as the trough cut into that fill. There is a difference in composition between the leaf mats flooring the trough and fill 1, with the former containing gray, less humified leaves and the latter featuring considerably darker, more organic and acidic variants. Stratigraphy favors separate origins for the leaf mats, though it does not argue for significant time gaps and therefore for discrete stratum designations. Accordingly, a leaf mat was initially swept onto the eroded canal bottom over the course of one or more fall seasons, relatively recently, when water flow was minimal. Canal fill 1 (stratum B) accumulated rapidly and spanned the width of the canal. Humification (i.e., leaf "blackening") proceeded in a subaerial context as standing waters percolated downward. Shortly thereafter, leaves from a succeeding depositional cycle marked the base of a trough incised into the canal 1 fill. In rapid succession strata D and C infilled the trough. Since these deposits are thicker and matrices are less permeable than those of canal fill 1, the leaf mat was not affected by standing water and, hence, the gray color.

These events apparently occurred rapidly and episodically, perhaps in a span of 5 to 10 years. Incision of canal fill 1 may be attributable to several dry years in the late 1970s, when downcutting was promoted. Canal fill 2 (stratum C), a clay-silt, was accreting over the course of the first (1982-1983) field season, as water levels in the canal were being frequently adjusted by the Pennsylvania Department of Environmental Resources. The wooden support mats effectively sealed in the surface, protecting it from subsequent erosion and large-scale sedimentation.

HISTORIC CONTEXT

The Commonwealth of Pennsylvania built the Delaware Division of the Pennsylvania Canal between 1827 and 1832 (Sheire 1976:Item 8, p. 2). In an era when poorly maintained, circuitous roads and unreliable natural waterways were the only forms of transportation available, the construction of the Delaware Canal was motivated by the need for an inexpensive, year-round means of transporting coal in large quantities from the western coal mines of the Lehigh Valley to the eastern seaboard (Sheire 1976:Item 8, p. 1). The success of the Erie Canal, begun in 1817 and completed in 1825, was the inspiration and model for Pennsylvania's canal-building. By 1842, the commitment to canals resulted in a system of some 1200 miles of canals in the state at a capital investment of $53,000,000 for the Commonwealth.

The Delaware Canal facilitated the development of iron smelting furnaces. Regionally, that industry grew after the discovery in 1838 that anthracite coal could be used in place of wood for smelting iron. Thus, the canal played a significant role in the development of the iron industry in Pennsylvania (Sheire 1976:Item 8, pp. 2-3). The canal also had an economic impact on the towns and communities along its route. Easton, at the intersection of three canals, developed into a transportation center. Bristol, at the other end of the Delaware canal, also prospered. Besides providing a means of transportation for local agricultural products, the canal presented new employment opportunities for the local populace and continued to create these as it facilitated industrial development and as canal use expanded in both volume and variety (Sheire 1976:Item 8, p. 8).

CANAL HISTORY

Date of Initial Planning and Development

Inspired by the success of the Erie Canal, the Pennsylvania legislature authorized the construction of the Delaware Division of the Pennsylvania Canal on April 9, 1827 (Sheire 1976:Item 8, p. 2). Beginning on July 9, the canal was surveyed from Easton to Bristol and on to Philadelphia, and the first dirt was excavated in a ceremony held October 27, 1827, at Bristol (Yoder 1972:14). Contracts for nearly 53-1/2 miles of the canal, the tidal basin at Bristol, and all of the mechanical work (dam and locks) except the construction of the locktenders' houses were let by mid-1829 (Yoder 1972:16-17). By December 21, 1830, water had been admitted to 25 miles of the Delaware Division, but porous soils and faulty construction caused the water to seep away, such that maintenance of the proper water level could not be achieved until repairs were made and feeder canals were constructed to supply additional water (Yoder 1972:17-19). The first boats, only partially loaded with 20 tons of coal, made the trip down the new canal from Easton all the way to Bristol in late July, 1832. By December 2, when the canal was closed for the season, boats with up to 50 tons of coal were navigating the canal. Problems continued to plague the canal, however, and it was 1834 before fully loaded boats, with up to 70 tons of coal, could use it (Yoder 1972:20-22).

Descriptions of Changes in Plan

Originally, the canal was intended to continue past Bristol and on to Philadelphia, an extra 17-1/2 miles. One of the first changes in plan for the canal was the decision to terminate the canal at Bristol in the interest of economy. About the same time, consideration was given to extending the canal above Easton to Port Jervis, an addition of 67 miles, but this division of the canal also was never authorized (Yoder 1972:15). A weigh lock at Easton was included in the plans for the canal at a rather late date in its construction period. The contract for the building of this weigh lock was approved in April, 1833. Use of the weigh lock at Easton was discontinued after Pennsylvania sold the Delaware Canal to a private company in 1858 (Yoder 1972:90,120). In the early planning stages of the Delaware Division, the width of the locks was the subject of some debate. Josiah White, the great entrepreneur of the Lehigh Coal and Navigation Company, wanted locks 22 feet wide, corresponding to those of the Lehigh Canal. The Delaware Division was merely an extension of the Lehigh Canal, which was conceived, built and operated by White's company. White wanted the locks on the Delaware to be capable of handling the same volume of tonnage as the Lehigh. When the designers of the Delaware insisted on narrower locks, White advised a width of 11 feet, so that at least one of his boats could go through at a time, if two could not be accommodated. This compromise reduced the freight volume of the Delaware Canal to 50 percent of that of the Lehigh and the Delaware and Raritan Canals (Yoder 1972:15, 21-22, 114).

The small locks of the Delaware Canal proved to be a problem throughout its years of service, and gradually, a number of them were replaced or enlarged and other changes and improvements were also made. Modifications and additions made while the Delaware Canal was still being operated by the State of Pennsylvania (prior to 1858) include:

1. building an outlet lock at Wells' Falls in 1847 to allow the passage of boats to the Delaware and Raritan Canal via the Delaware River (Yoder 1972:88, 117);

2. combining and replacing in 1852 pairs of neighboring, narrow locks at New Hope and Uhler's with single locks, 22 feet wide, of a higher lift than the originals and with "fall" gates instead of the original miter gates at the upstream end (Yoder 1972:85-6, 118);

3. replacing the original culvert under the canal for Fry's Run with an aqueduct at an unknown date (Yoder 1972:92); and

4. increasing the depth of the canal to 6 feet from Easton to New Hope c. 1858 (Yoder 1972:119).

In 1858, when the Commonwealth divested itself of its canals, the Delaware Canal eventually came into the hands of the Lehigh Coal and Navigation Company, which had been the primary user of the canal since its inception. The first change made by the LC&N Co. was to discontinue use of the weigh lock at Easton, which had been used to determine the tolls due the Commonwealth from boats entering the Delaware Canal (Yoder 1972:90). Later, a change was made in the kind of mechanism used to open the lift lock miter gates from a balance beam to the "dog house" with its rack and pinion gears. Just when this change took place is not known, but there is a strong possibility that it was part of the massive repairs which the LC&N Co. had to undertake in the aftermath of the ravages of the great flood of 1862, which put the canal out of operation for four months (Yoder 1972:85, 120-121). The hard-learned lessons of this disaster caused the company to institute a policy of bank raising and strengthening, which was completed in 1878 (Yoder 1972:120). The LC&N Co. also continued the lock enlarging program begun by the State. The Smithtown locks were replaced by a double lock with a higher lift in 1868, and the Narrows lock was doubled at about the same time (Yoder 1972:119). Under the management of the LC&N Co. the canal was kept in good order for the remainder of its period of commercial use.

The canal was donated back to the State in 1931 and Roosevelt State Park was created from the canal property. However, legal problems about the transfer kept the State from taking possession and responsibility until 1940. Lack of maintenance during the 1930s and another severe flood in 1936 left the canal in poor condition. Since the acquisition of the canal by the Department of Forests and Waters, several aqueducts have had to be replaced and additional flood damages from the year 1955 have had to be repaired. Several locks have had to be stabilized or reconstructed. The Point Pleasant locks, Nos. 13 and 14, were rebuilt in 1947 and are fully functional, but the replacement mechanisms for the operation of the slide valves (for letting water in and out of the locks) came from the larger gates of the Schuylkill Canal and are not typical of Delaware Canal equipment (Yoder 1972:62). The terminal end of the canal, including three lift locks, the tide lock and the tidal basin, were surrendered by the State to the City of Bristol in 1954. The basin had been filled in previously and locks No. 1, 2 and 3 were demolished. However, the upper 59 miles of the canal is intact and holding water, and it largely retains its nineteenth century character (Yoder 1972:235; Sheire 1976:Item 7, p. 2).

No detailed study of the physical evolution of the canal has been done, but two sets of original maps of the canal exist which would provide invaluable data for such a study. Map of the Delaware Division of the Pennsylvania Canal, 1828-30 was drawn by A. W. Kennedy. It consists of 23 plates and is in the collections of the Pennsylvania State Archives in Harrisburg. Mao of Delaware Division Canal from Surveys Made in April and May 1868 for the Delaware Division Canal Co. . . .and the Lehigh Coal and Navigation Co. . . . was assembled by Thomas S. McNair. There are 50 plates. This resource is also in the collections of the Pennsylvania State Archives in Harrisburg.

Individuals Associated with the Site

The state senator who sponsored the bill authorizing the construction of the Delaware Canal was Colonel Peter Ihire of Easton. Col. Ihire was also the dignitary who removed the first shovelful of earth for the ground-breaking ceremony at the initiation of the canal's construction at Bristol (Yoder 1972:14, 16). Henry G. Sargent was the engineer chosen for the design, survey and cost estimate for the canal (Yoder 1972:14). The official appointed to negotiate, supervise and coordinate the work of the contractors during the construction of the canal was Thomas G. Kennedy (Yoder 1972:15). The president of the Canal Commission of the State of Pennsylvania during the construction of the canal was James S. Stevenson. Stevenson, in a report submitted at the end of 1830, left the most thorough description of the Delaware Canal as originally planned and built (Yoder 1972:18-19).

Josiah White and his Lehigh Coal and Navigation Company were a major impetus behind the decision to construct the Delaware Division of the Pennsylvania Canal (Yoder 1972:15). White and two associates began coal-mining operations near Mauch Chunk in 1818, and to make this venture profitable, White had to solve two transportation problems:

1. getting the coal from the mines on the rugged mountainside to the boats on the Lehigh River; and

2. getting the coal down the treacherous and unreliable Lehigh River to the domestic markets in the cities of Philadelphia and New York.

White's solutions to these problems were innovative and ingenious, and inspired both imitation and further evolution in transportation technology (Yoder 1972:128-129).

To move his coal from the Mauch Chunk mines down the steep side of a mountain to the Lehigh River, White conceived and built the first railroad in the United States. Loaded coal cars and a special wagon carrying mules ran on tracks down the mountain by force of gravity. Then the empty cars were hauled back up the mountain by the mules and the whole circuit was run again. The mules were even fed on their trip down the mountain in order to save time. Josiah White's nephew later bragged that not only had his uncle built the first railroad, but he also had provided the first transportation of livestock by rail and the first railroad dining car (Yoder 1972:128).

With State permission, in 1818 White began improvements on the Lehigh River which were effected in 1823 in the routine, one-way navigation of that river by coal-laden arks. These improvements consisted of the removal of obstacles such as log jams and the construction of a series of V-shaped dams which could be opened by means of locks to produce controlled floods to float the arks over shallows (Yoder 1972:128, 147). Not satisfied with just one-way navigation, in 1827 the LC&N Co. engaged the services of Canvass White, who had worked on the Erie Canal, to supervise the design and construction of a canal between Easton and Mauch Chunk. This canal opened in June of 1829 (Yoder 1972:148). The success, dependability, and commercial potential demonstrated by this first section of the Lehigh Canal promoted the decision to build the Delaware Canal in order to extend two-way navigation between the interior of Pennsylvania and the port and markets of Philadephia.

While the advantages to the LC&N Co. of the Delaware Canal are obvious, White actually would have preferred that navigation improvements (locks and channelization) be made on the Delaware River rather than that a canal paralleling the river be built (Yoder 1972:22). Thus it is ironic that it was White to whom the Canal Commissioners turned when the Delaware Canal failed to hold water due to hasty and incompetent construction. White commented, "The constructors on the Delaware was [sic] permitted to fill up the canal to bottom with bad material and when reported to be finished, would not hold water. It was then put under my charge to make it a good job, which I was only able to effect by overhauling a large part of it" (Yoder 1972:19). White's contributions to the canal were manifold and the association with the canal of this man whose genius enhanced both American business and technology greatly augments the historical significance of this early engineering achievement.

Historical Events or Developments Associated with the Site

One noteworthy event occurred at the juncture of the Lehigh and Delaware Canals that presaged a movement critical to the emergence of the coal industry by the end of the nineteenth century. In mid-winter of 1841 a disastrous flood damaged the Lehigh and Delaware Canals to such an extent that navigation on the upper part of the Lehigh Canal was not restored until 1844, and navigation on the Delaware Canal was delayed until August by bank repairs. In 1843, spring rains delayed the start of the working season on the canals by a month, causing the boatmen waiting on their loaded boats at Easton to become concerned about another bad year. When the delay was extended by another two months due to additional canal bank breaks, the frustration and anger of the boatmen, who would not be paid by the Lehigh Coal and Navigation Company until they could get their loads to Bristol, reached the combustible stage. When the Delaware Canal was reopened, the boatmen declared a "turnout," or strike. Having gone for a very long time without pay, they demanded higher wages and assurance of regular work. A boat was sunk in the weigh lock so that no other boats could pass through into the Delaware Canal. A riot was threatened and militia had to be called out several times to prevent vandalism. The miners at Mauch Chunk even joined the boatmen's strike in sympathy, but the LC&N Co. emphatically refused to be moved by what it considered a conspiracy. The men returned to work in August, with the boatmen that much the worse off for having further shortened their working season. While none of the participants in or spectators of this event probably realized its import, in just a few more decades the labor movement would be much more successful in asserting and achieving its ends (Yoder 1972:136-137).

One important development associated with the Delaware Canal concerns the use of anthracite coal for the smelting of iron. Josiah White was certain that this procedure was feasible, but it was 1838 before the British-patented design for a coal-fired iron furnace was bought by White; the first successful smelting operation using coal was set up by Lehigh Coal and Navigation Company at Mauch Chunk. In 1848, a new iron furnace utilizing this smelting process was established near the abandoned eighteenth-century Durham Furnace. The new furnace location was close to the Delaware Canal and to the confluence of Durham Creek and the Delaware River. This industrial development was able to take advantage of the abundant iron ore, limestone, and water supplies in the vicinity and the new availability of coal delivered by canal boats from the Lehigh Valley. The successful production of high quality iron continued at Durham Furnace through the first decade of the twentieth century (Yoder 1972:211-214).

PHYSICAL DESCRIPTION OF THE SITE

Original Plan

James S. Stevenson, president of the Canal Commissioners at the time of the building of the Delaware Division of the Pennsylvania Canal, made a progress report, dated December 21, 1830, which provides the best description of the canal as it was conceived and built:

> On this division the width of the canal at bottom is 25 feet, at top water line 40 feet, and its depth of water, 5 feet. In its course there are 23 lift locks, ranging from 6 to 10 feet lift, also 2 outlet and 2 guard locks. The canal and locks are arranged for boats of 67 tons burden. Eighteen lock keepers are necessary in this division.

The lift locks are 11 feet wide and 95 feet long, clear in the chamber. They are constructed of rubble masonry layed in cement on timber bottoms with longitudinal sills and upright posts faced with planks spiked to the timbers. The tide lock at Bristol, guard lock at Easton and the outlet lock into the River Delaware from the pool at Easton are 22 feet by 100 feet long, clear in the chamber. The guard lock at New Hope is 18 feet by 100 feet and affords a communication with the River Delaware.

Nine aqueducts, the shortest 25 feet, the longest 178 feet between the abutments. The abutments and piers are of rubble masonry, the superstructure of wood trunks 20 feet wide, towpath bridge forming part of the superstructure. Twenty culverts, rubble masonry layed in cement. Nineteen waste weirs with slide gates, woodwork with protective masonry. Sixteen lock houses built. Tide basin of 5-1/2 acres constructed in the Delaware and the pier at Bristol nearly finished. Forty-seven road bridges, stone abutments, superstructure of wood. Forty-nine farm bridges, three turnpike and three foot bridges (Yoder 1972:18-19).

Reconstructed Site Setting

Following construction and excavation activities at the Pumping Station site, the Department of Environmental Resources undertook the restoration of the canal embankments. A profile and plan of the restored canal segment (DER 1985) shows that the following procedures were implemented:

1. Both embankments and an 18 inch thick canal liner were completely reconstructed with clay backfill.

2. The east embankment was removed and replaced to 8.5 feet in depth.

3. The west embankment was removed and replaced to 4.0 feet in depth.

4. All of the slope areas were seeded by the Parks Department.

Currently, construction activities have ceased and there have been no adverse impacts on the canal. Stabilization inspections are periodically conducted by the Pennsylvania Department of Environmental Resources.

BIBLIOGRAPHY

Sheire, James
1976 Nomination Form for Delaware Canal: National Register of Historic Places. Report on file at Office of State Historic Preservation, Harrisburg, Pennsylvania.

Yoder, C. P.
1972 Delaware Canal Journal: A Definitive History. Canal Press, Bethlehem.

Figure 1

North Wall Profile of Floor and Canal Sides
Pennsylvania Canal at Point Pleasant (Between Locks 13 and 14)

ARCHEOLOGICAL AND HISTORIC INVESTIGATIONS AT 36BU23
PT. PLEASANT, PENNSYLVANIA

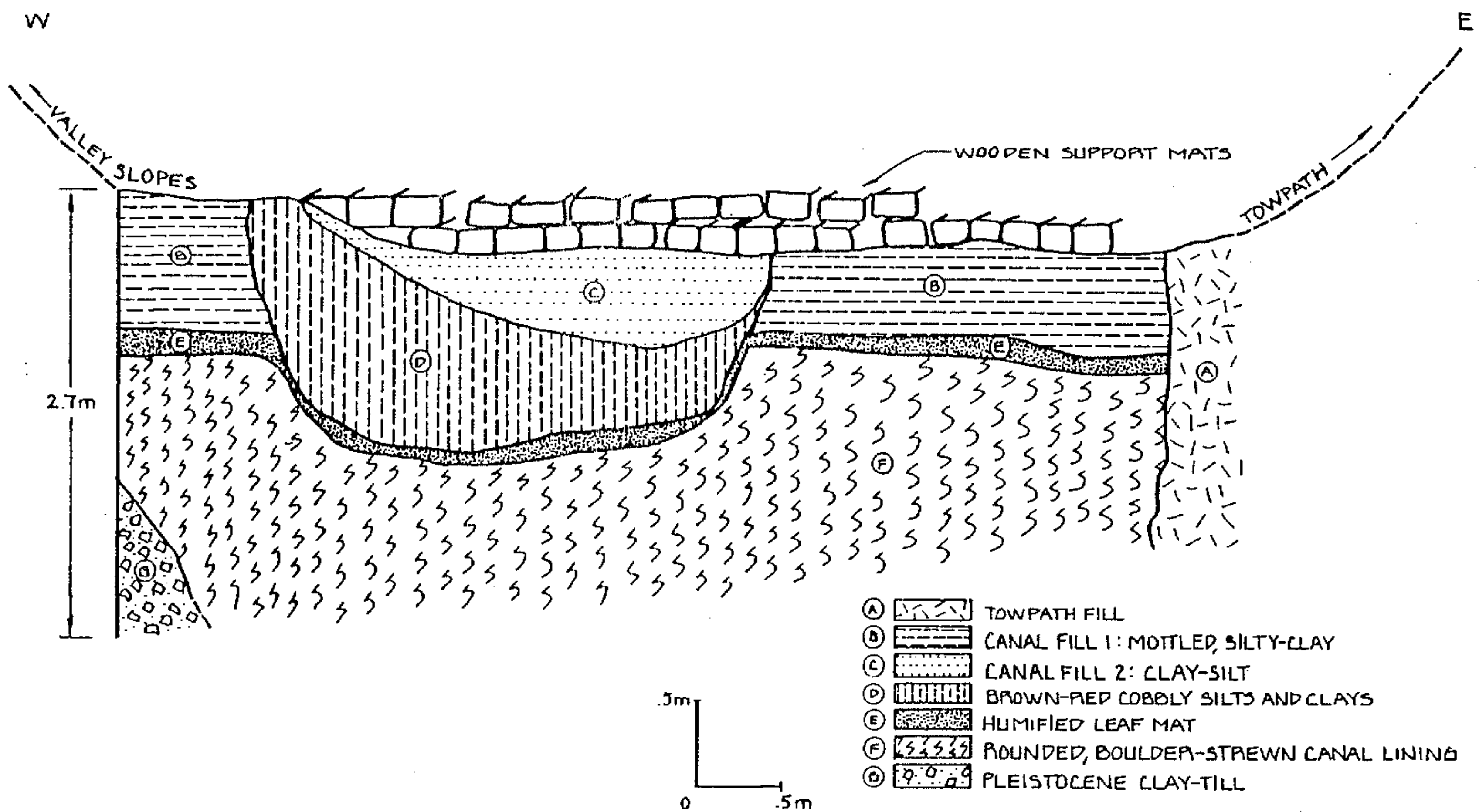

TABLE 1

SEDIMENTOLOGY AND STRATIGRAPHY AT SITE 36BU23

Canal Stratum	Depth (cm)*	Sedimentology and Stratigraphy	Lateral Distribution and Depositional Environment
A	0-400 (Riverside)	10YR4/1 and 10YR3/2 silts, sands and rubble with 5YR5/8 mottles and streaks. Matrix is disturbed, but incorporates prismatic structures, granular clumps, and hardened mottled clasts. Heterogeneous compaction is due to presence of mixed historic and prehistoric fills together with tabular and pitted river gravels, argillite flakes (cultural and non-cultural), weathered fragments and decayed organics. Lower contact is smooth and regular.	Occurs as a capping fill sealing in pre-canal surfaees that pre-date 1832. Much of the fill comes from wetlands basins to the north of the prehistoric (Mercer) mound site. Fill was used to construct the towpath between locks 13 and 14.
B	150-220	10YR3/2 mottled silty clay. Matrix has firm consistence and includes very weak subangular blocky structures, granular clumps and diverse recent historic artifacts. Most artifacts are fragmented and metals are rusted. Lower contact is sharp and abrupt.	This is the shallowest but most extensive canal fill and probably dates to the past 40 years. It includes considerable debris dropped into the canal trough in very recent times.
C	150-200	10YR4/1 clay-silt with minimal mottling. Matrix is firm with very weak subangular blocky structures. Minimal artifacts are contained in sediment, but there are well rounded small gravels. Lower contact is abrupt and sharp.	Deposition accreted in a trough cut into upper canal fill. It appears to be the product of a rapid and episodic deposition, probably within the past 10 years.
D	220-260	5YR4/3 cobbly silts and clays with firm but heterogeneous consistence. Structure is firm subangular blocks; peds break off at contacts with large clasts. Cobbles include granite and quartz rocks that are pitted and subangular in shape. Lower contact is abrupt and sharp.	Sediment has appearance of a reworked till, swept in from the valley sides. Very possibly it is derived from a tributary (i.e., Hickory Creek) and was transported, lining the base of the upper canal fill. It is not possible to determine whether or not this is a legitimate (i.e., constructed) canal lining.

*Depth refers to surface level at towpath elevation; fills begin at 150 cm.

TABLE 1 (Cont'd.)

Canal Stratum	Depth (cm)*	Sedimentology and Stratigraphy	Lateral Distribution and Depositional Environment
E	220-230 (under B); 260-270 (under D)	10YR3/1 humified leaf litter which is grayer in deeper (i.e., central) trough. There is no sediment in direct association with the stratum.	Leaf mat is black under stratum B and gray under stratum D. It is unclear whether or not one depositional event is signalled, since a 10 cm thick stratum underlies both the deeper, narrower incised trough and the primary (upper) canal fill. In any case, a major change in canal depositional history is suggested following stabilization of the lining (stratum F).
F	> 230	10YR4/1 bouldery clay-silt canal lining with firm consistence. Boulders and cobbles are 20-80 mm in size, well-rounded and water-worn; they are dispersed throughout matrix. Clay structures are medium prismatic and extremely cohesive with high shear resistance. Lower contact not reached.	This is the impermeable lining used to seal the canal walls and prevent seepage. Morphology of the boulder-cobbles and the consistence and composition of the parent clay matrix suggest that the lining was made of locally available floodplain and till clays. This was done in the mid-nineteenth century.
G	> 300 (Roadside)	10YR3/3 silt-clay with abundant sub-rounded to subangular medium (20-100 mm) gravels that are pitted and moderately tabular. Parent matrix coarsens up the sequence. Lower contact not reached.	Origins of matrix are problematic. They either represent reworked boulder-clays of the Muncy till (Illinoian) or a saprolite derived from slope erosion. Brown colors and absence of well-rounded stones may argue against till origins, as would mapped limits of the Illinoian advance (10 miles north of project area).

*Depth refers to surface level at towpath elevation; fills begin at 150 cm.